

1940



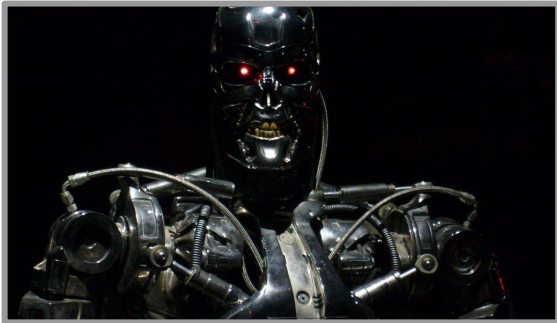
1970



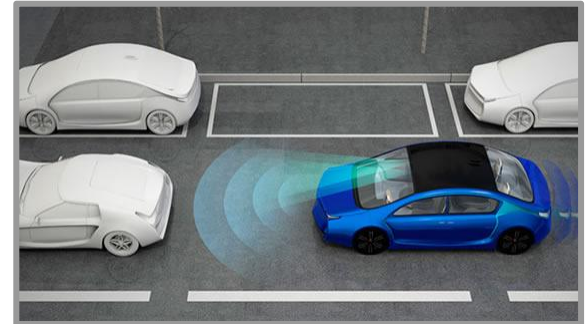
2019

# Artificial Intelligence (AI)

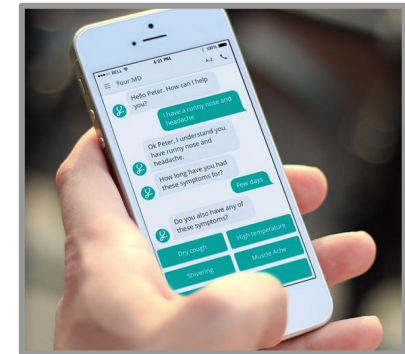
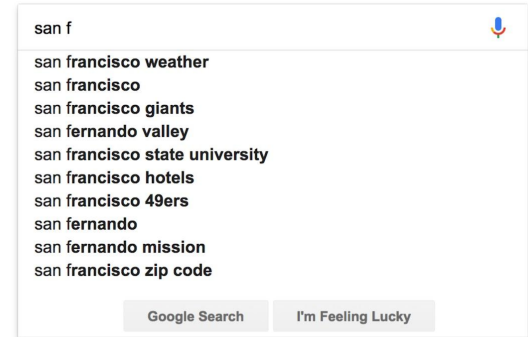
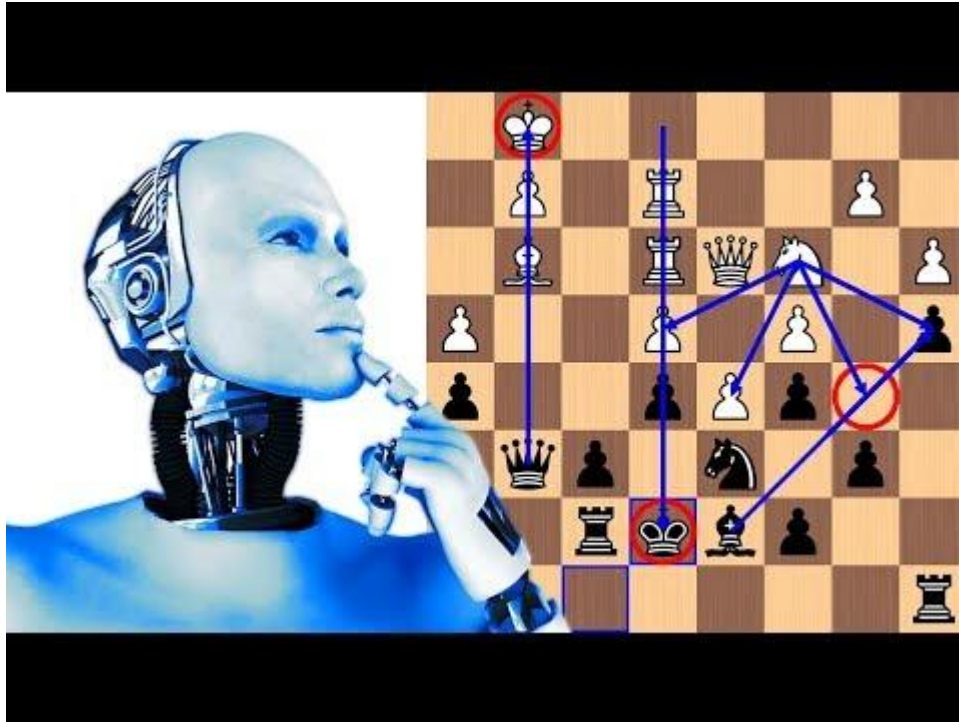
**EXPECTATIONS**



**REALITY**



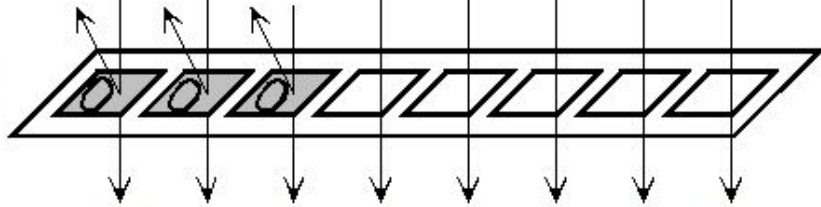
# Machine Learning



# The Atomic Scale

Data Input

1 0 1 1 0 1 1 0

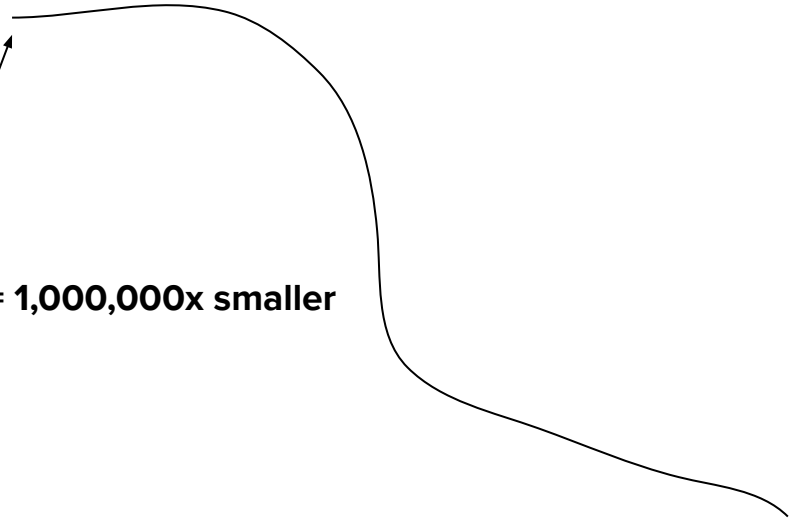


0 0 0 1 0 1 1 0

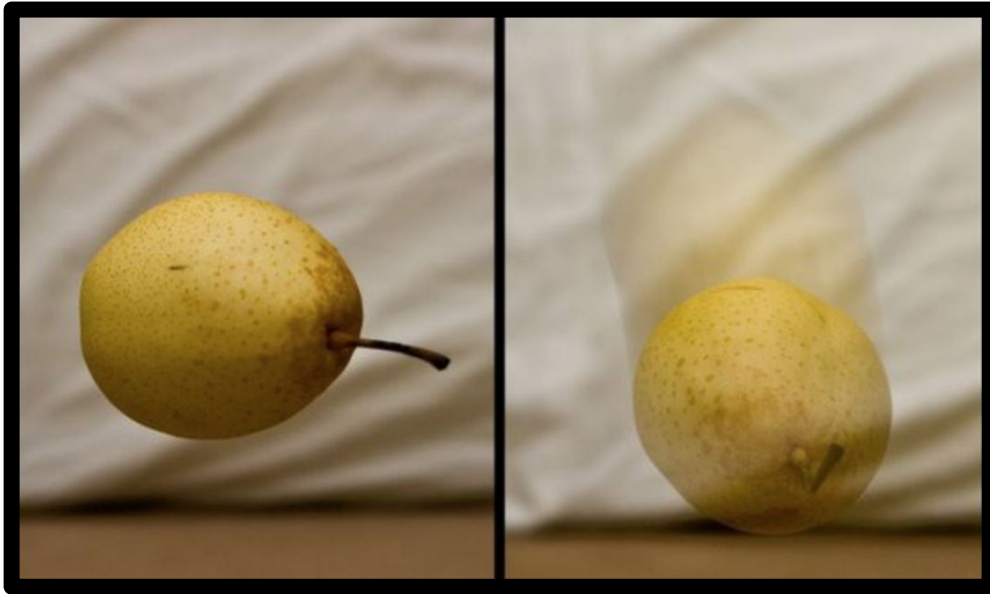
Data Result



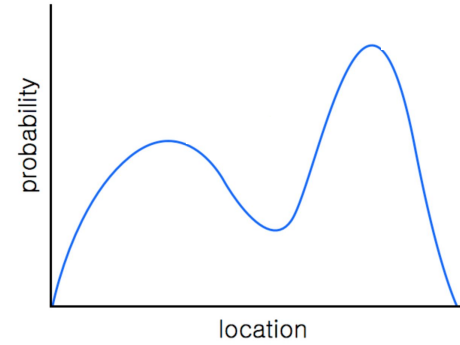
= 1,000,000x smaller



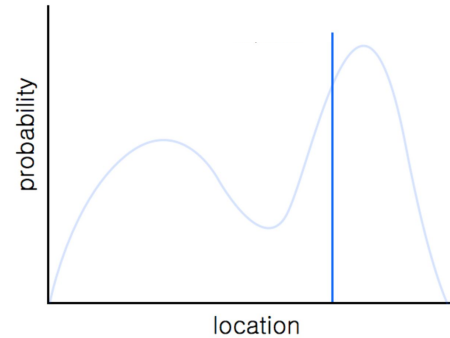
# Heisenberg's Principle



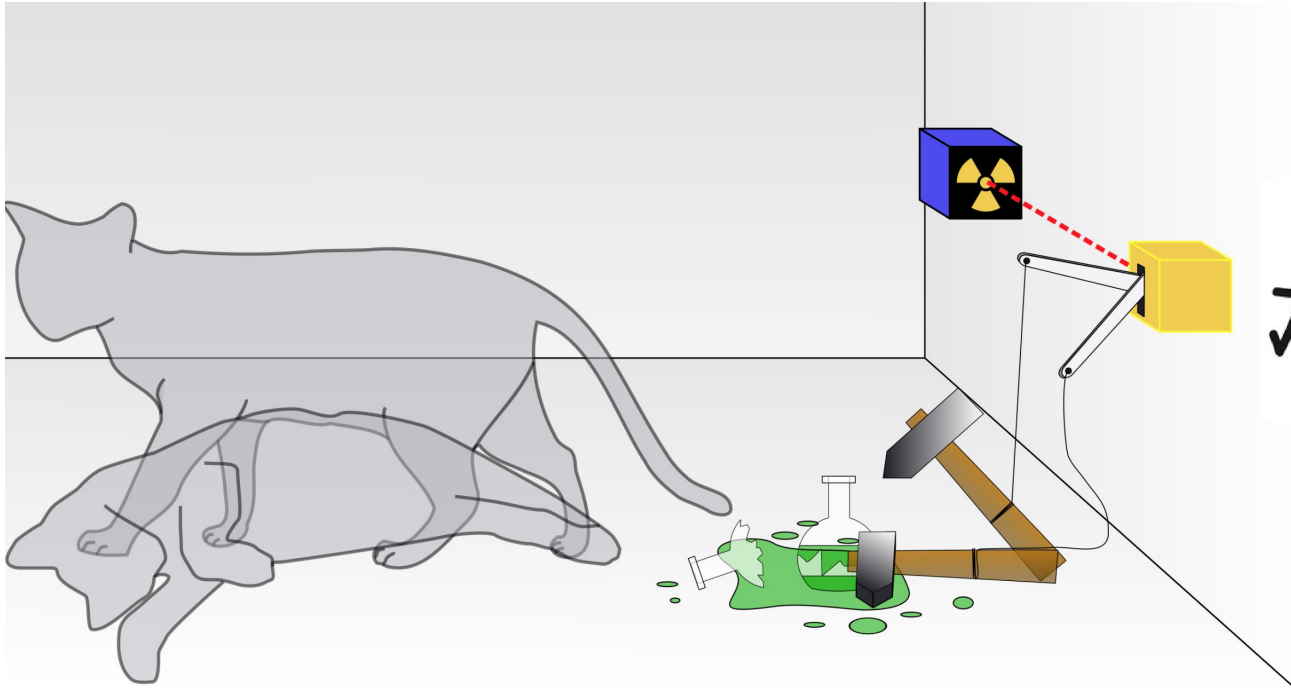
BEFORE MEASUREMENT



AFTER MEASUREMENT



# Schrodinger's Cat



$$\frac{1}{\sqrt{2}}|\text{cat}\rangle + \frac{1}{\sqrt{2}}|\text{dead}\rangle$$

# Superposition

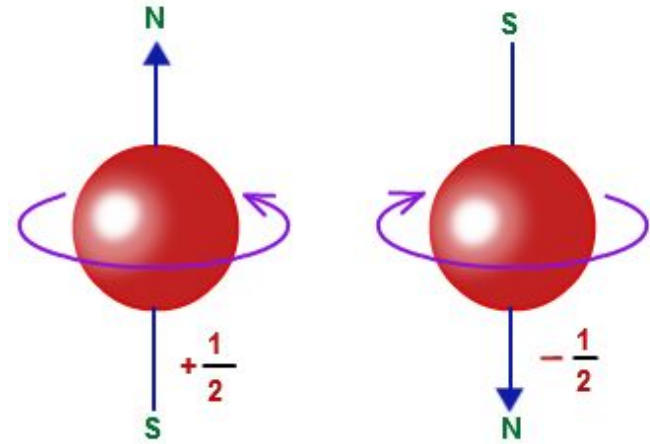
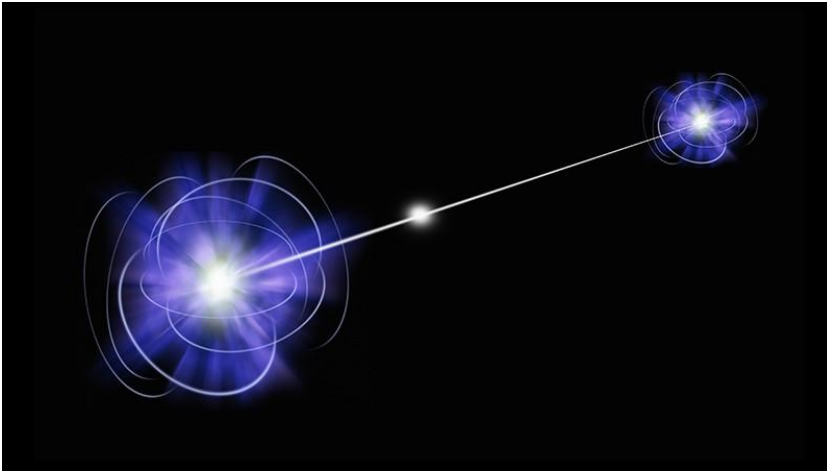


Possibilities: **1, 0, 10, 01**

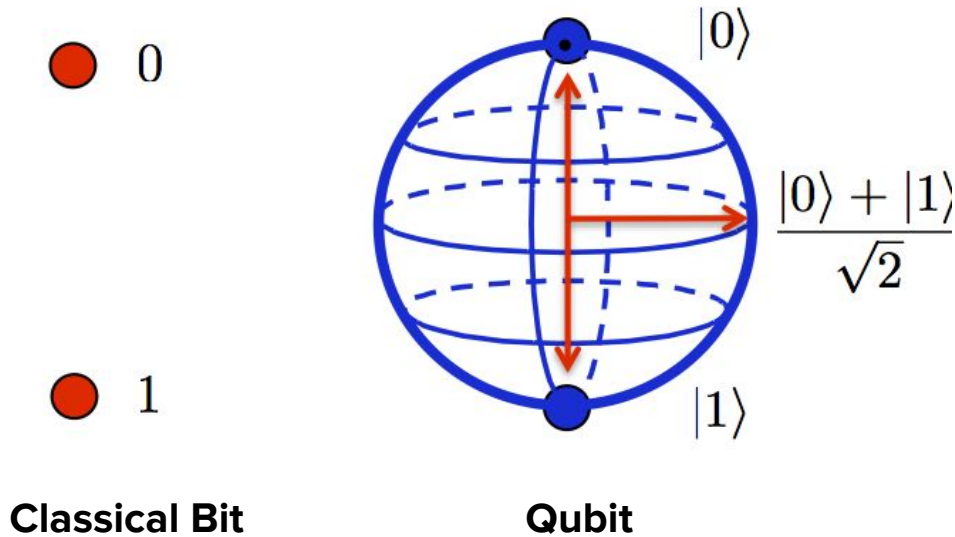


# Entanglement

“Spooky action at a distance” - Einstein

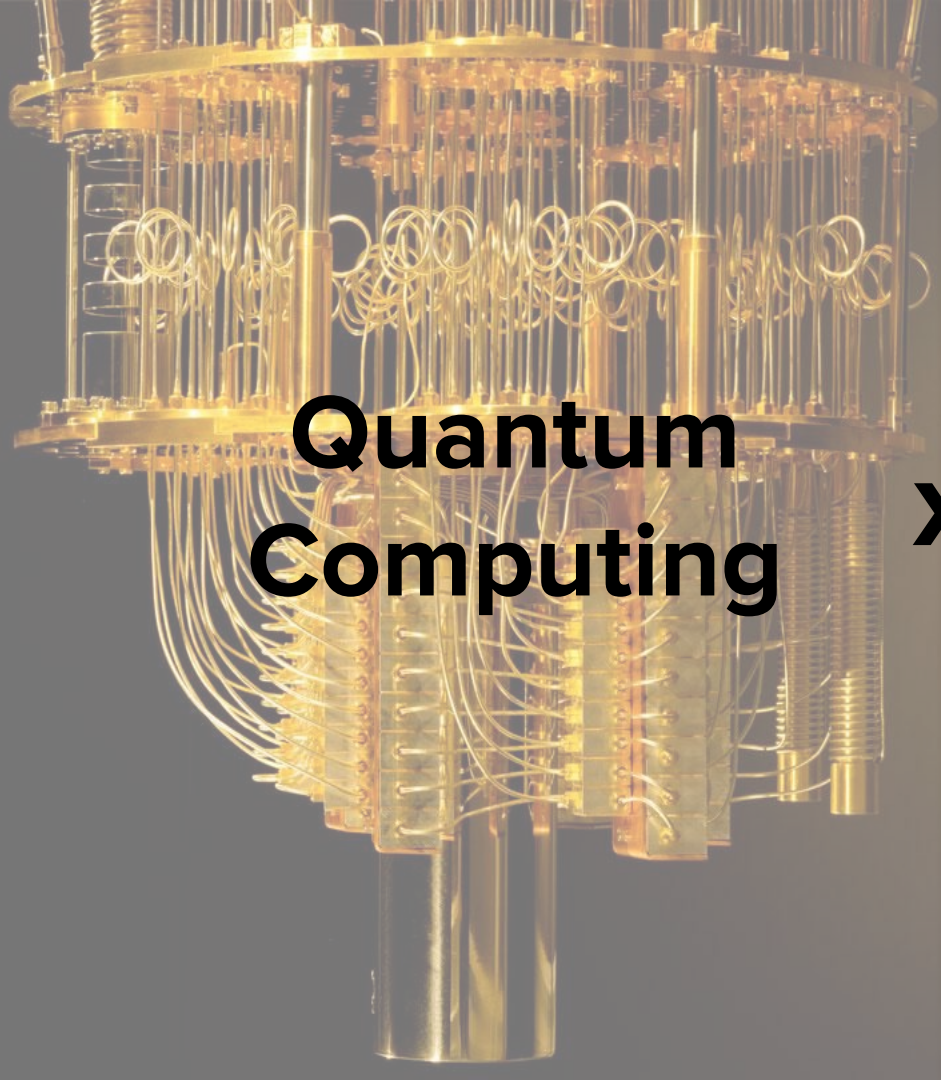


# The Quantum Advantage



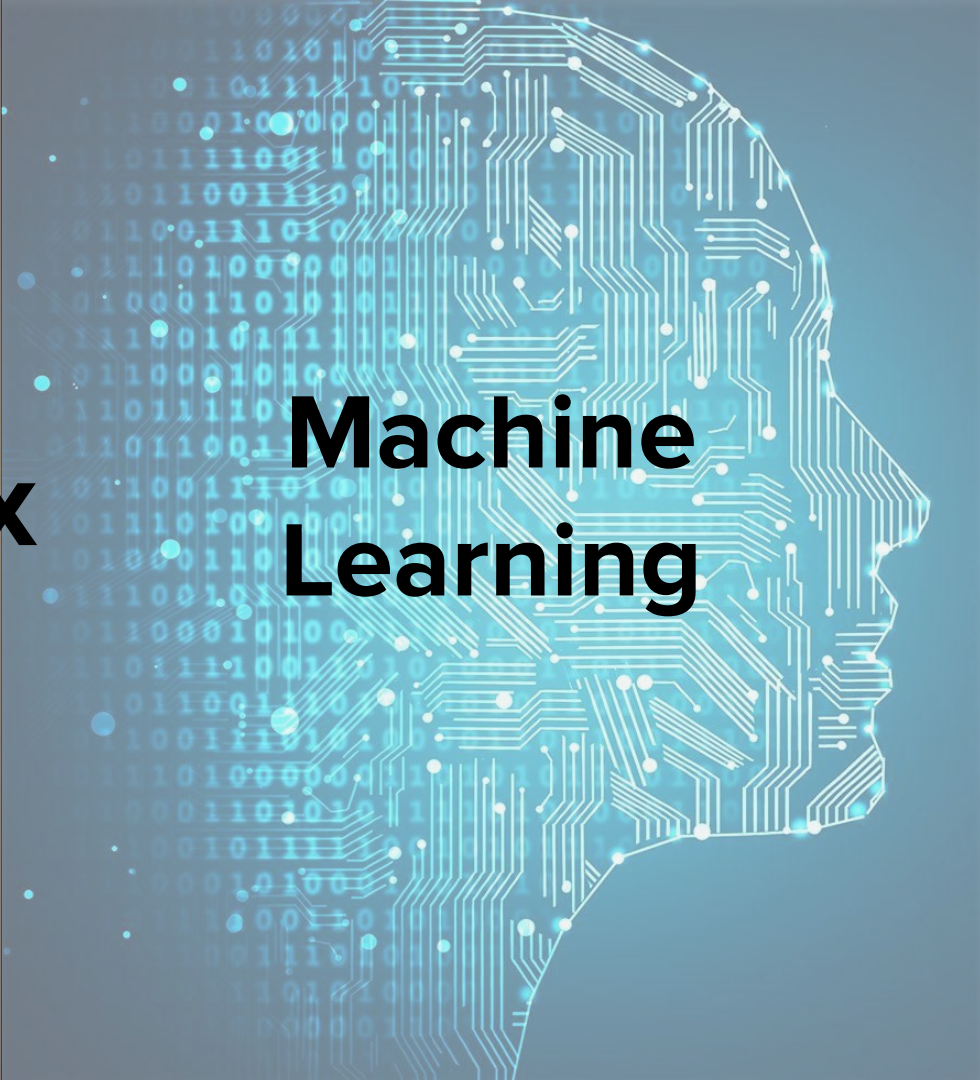
$n$  qubits =  $2^n$  solutions

**Quantum Advantage:**  
*Speedups*  
*Optimization*



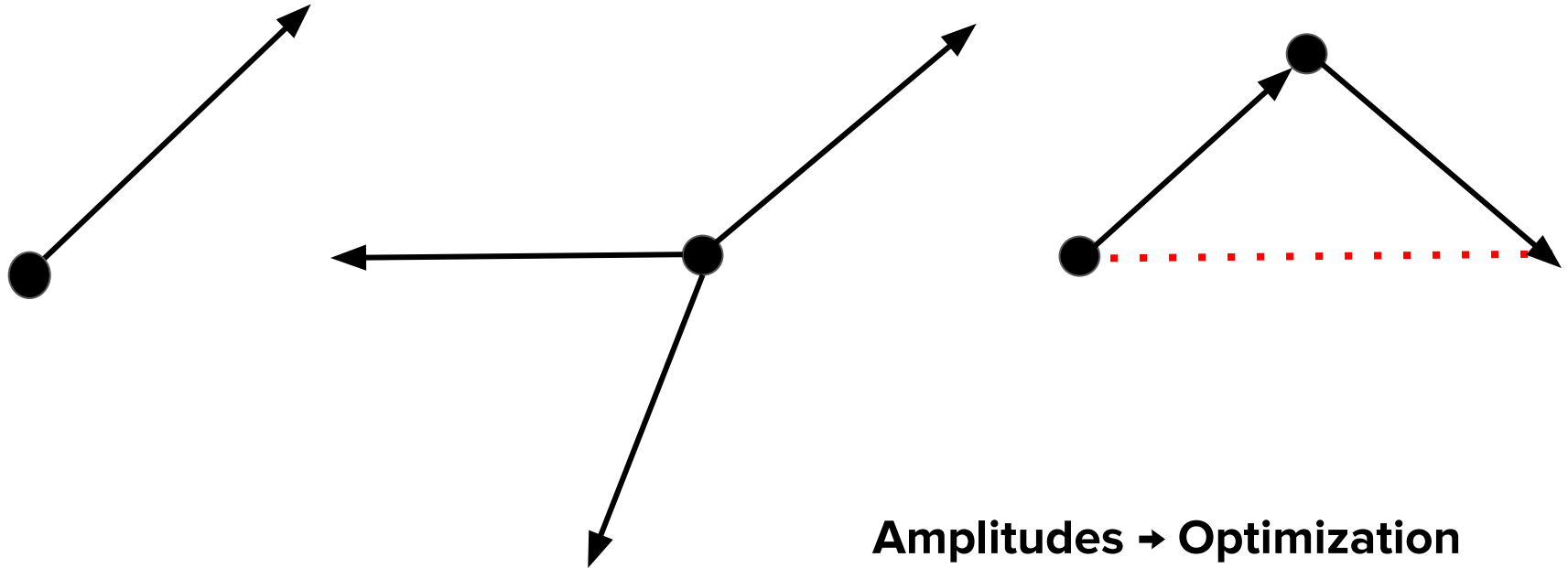
**Quantum  
Computing**

**X**

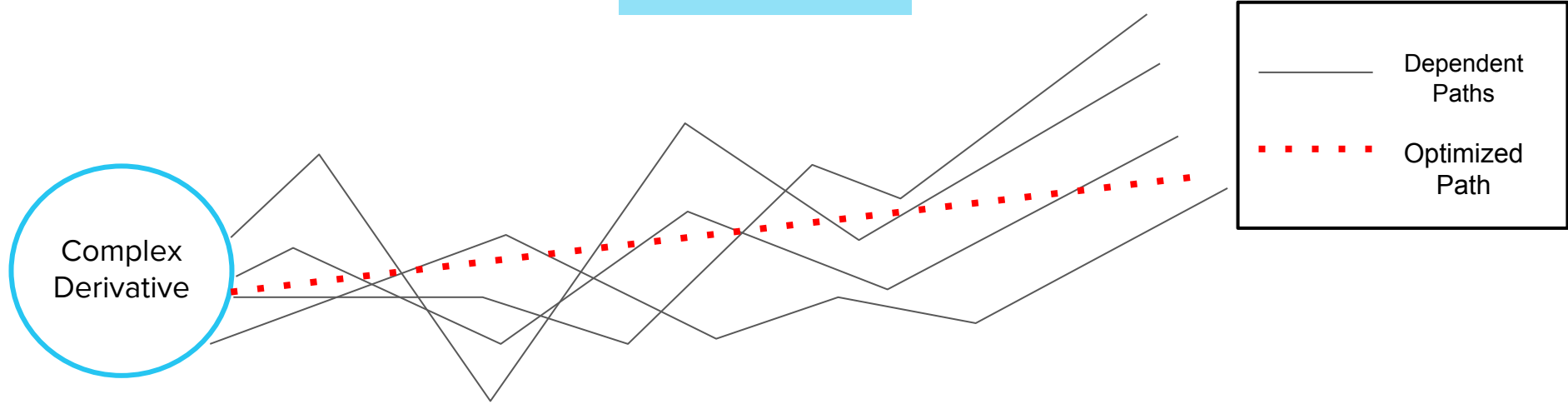


**Machine  
Learning**

# Quantum Machine Learning

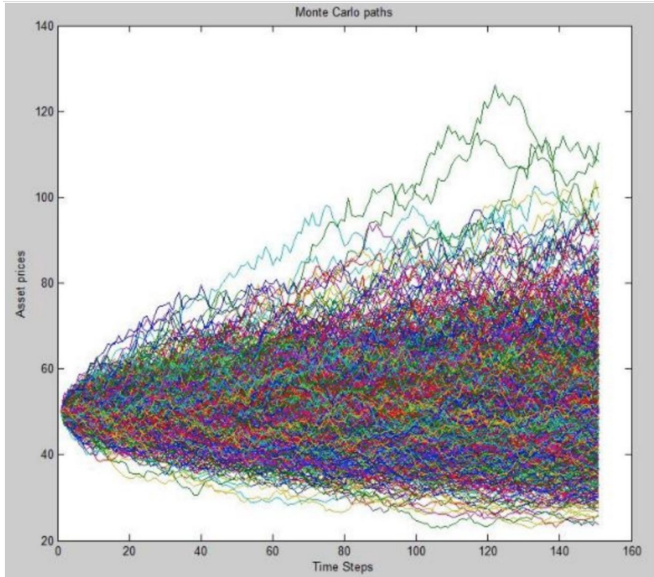


# Finance



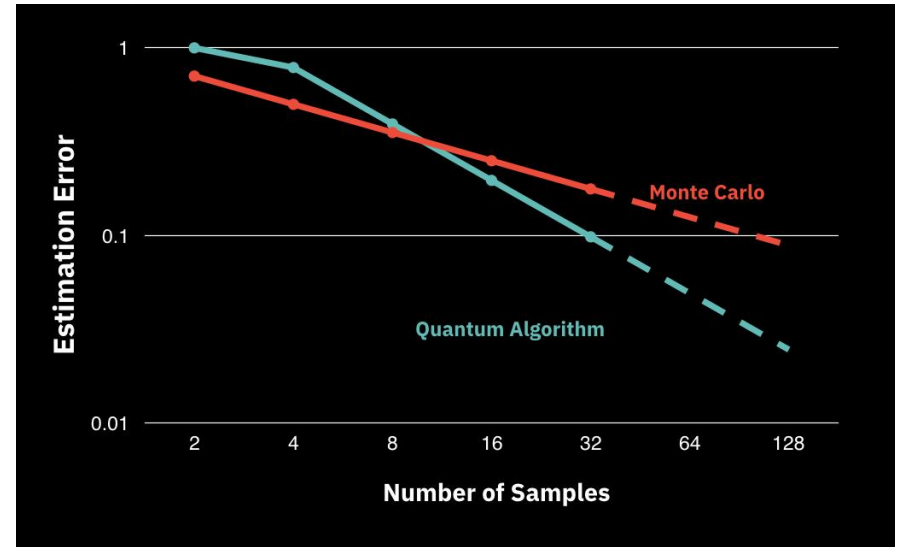
# Credit Risk Analysis

Monte Carlo (Today's Method)



*Quantum Amplitude Estimation =  $x^4$  faster*

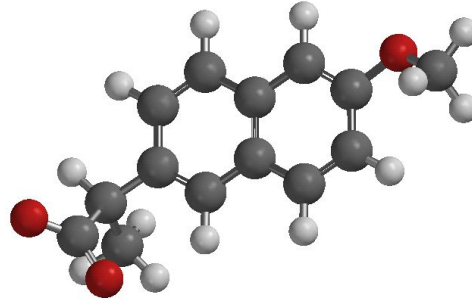
Quadratic Speedup Over Monte Carlo



Estimated Value at Risk:	2
Exact Value at Risk:	2
Estimated Probability:	0.962
Exact Probability:	0.959

# Healthcare: Drug Discovery

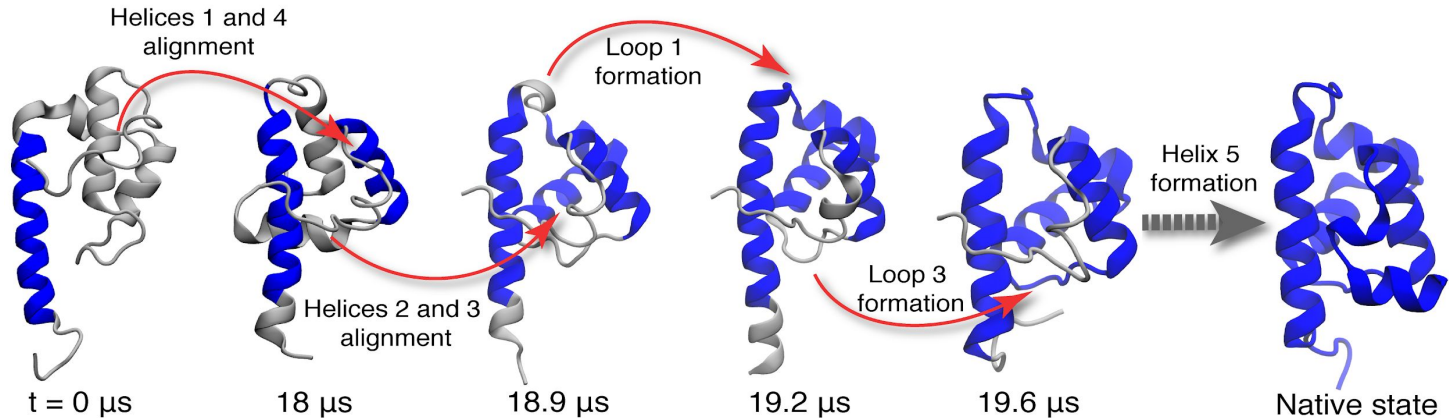
Treatment



Side Effects



Years → Weeks



# Space Exploration

Autonomous Exploration

Discover Planets

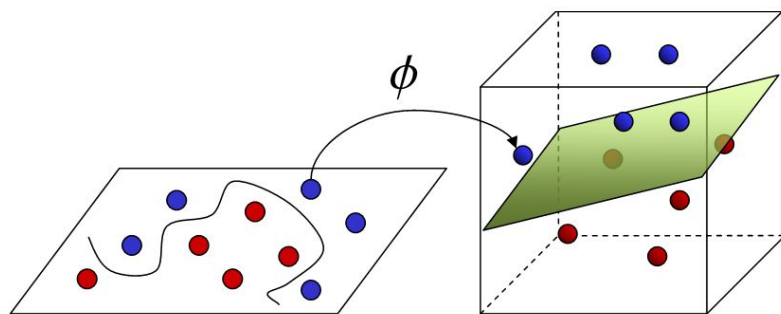
Remote Sensing

Forecasting





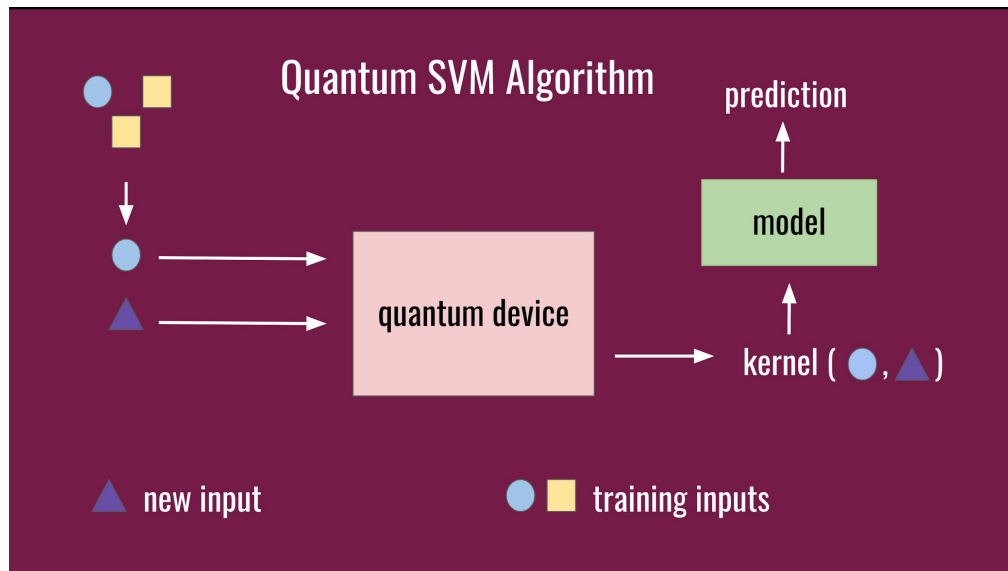
# Quantum SVM's: Cell Detection



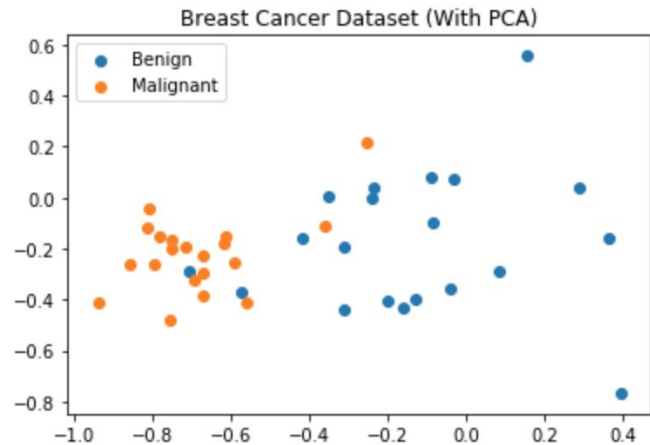
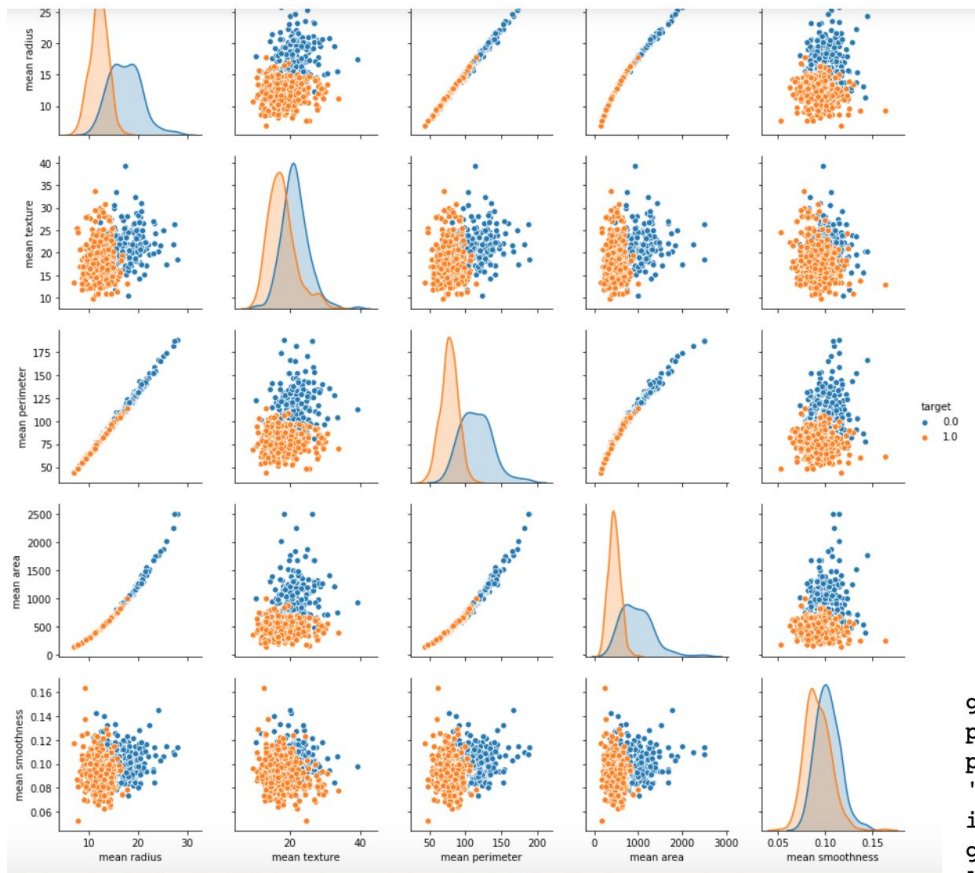
Input Space

Feature Space

*Support Vector Machine (SVM)*



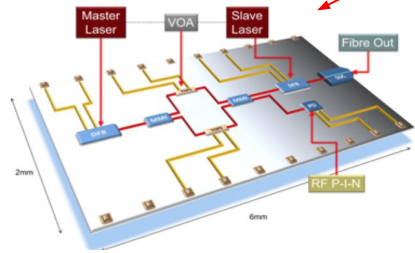
*Quantum Algorithm*



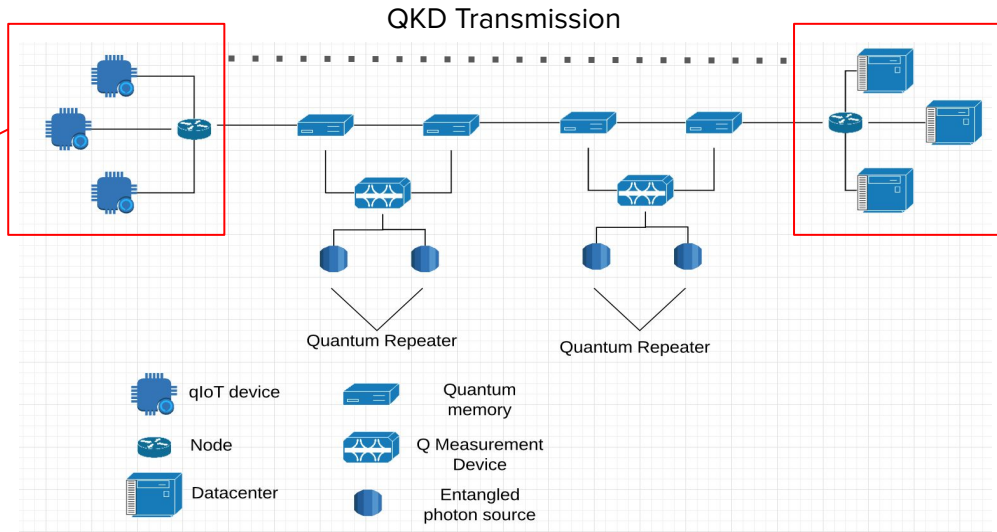
{'Benign': 0, 'Malignant': 1}

```
algo_input = ClassificationInput(training_input, test_input, total_array)
result = run_algorithm(aqua_dict, algo_input)
```

```
ground truth:  [0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1]
prediction:    [0 1 0 0 0 1 0 0 1 0 1 1 0 1 1 0 1 1 1]
predicted class: ['Benign', 'Malignant', 'Benign', 'Benign',
                  'Benign', 'Malignant', 'Benign', 'Benign', 'Malignant', 'Benign',
                  'Malignant', 'Malignant', 'Benign', 'Malignant', 'Malignant', 'Malignant',
                  'Malignant', 'Malignant', 'Malignant']
accuracy:      0.75
```



Transmitter



Receiver

# Resources

## Linear Algebra:

- 3Blue1Brown: [Essence of Linear Algebra](#)
- Khan Academy: [Linear Algebra](#)

## Books:

- Martin Laforest [QCSYS Textbook](#)
- Nielsen, Chuang [Quantum Computation and Information](#)

## Quantum Programming:

- Q# [Katanas](#)
- Qiskit [Tutorials](#)
- Xanadu [Library](#)
- Cirq [Library](#)

\*All free online!

## Courses:

- MIT edX [Quantum Information Science](#)
- Coursera [Intro to Quantum Computing](#)

## Contact Me:



**Email:** [aliceliu2004@gmail.com](mailto:aliceliu2004@gmail.com)

**LinkedIn:**  
<https://www.linkedin.com/in/alice-liu-16ba6818b/>

**Website:** [aliceliu.com](http://aliceliu.com)